

THE IMMATURE STAGES OF *DIALYSIS FASCIVENTRIS* (LOEW)
(DIPTERA: COENOMYIIDAE)

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Abstract.—The immature stages of *Dialysis fasciventris* are described and the phylogenetic relationships of the genus *Dialysis* with other genera of lower brachycerous Diptera are discussed.

Twelve species of the genus *Dialysis* are known worldwide: nine species in North America (Webb, 1978), two species in Japan (Matsumura, 1916; Nagatomi, 1953), and one species in Formosa and South China (Bezzi, 1912). The immature stages of these species are undescribed. It is the intention of this paper to describe the larval and pupal characters of *Dialysis fasciventris* (Loew) and to discuss the phylogenetic relationships of the genus *Dialysis* with other genera of lower brachycerous Diptera.

The terminology used for the immature stages is from Teskey (1969, 1981).

Dialysis fasciventris (Loew)

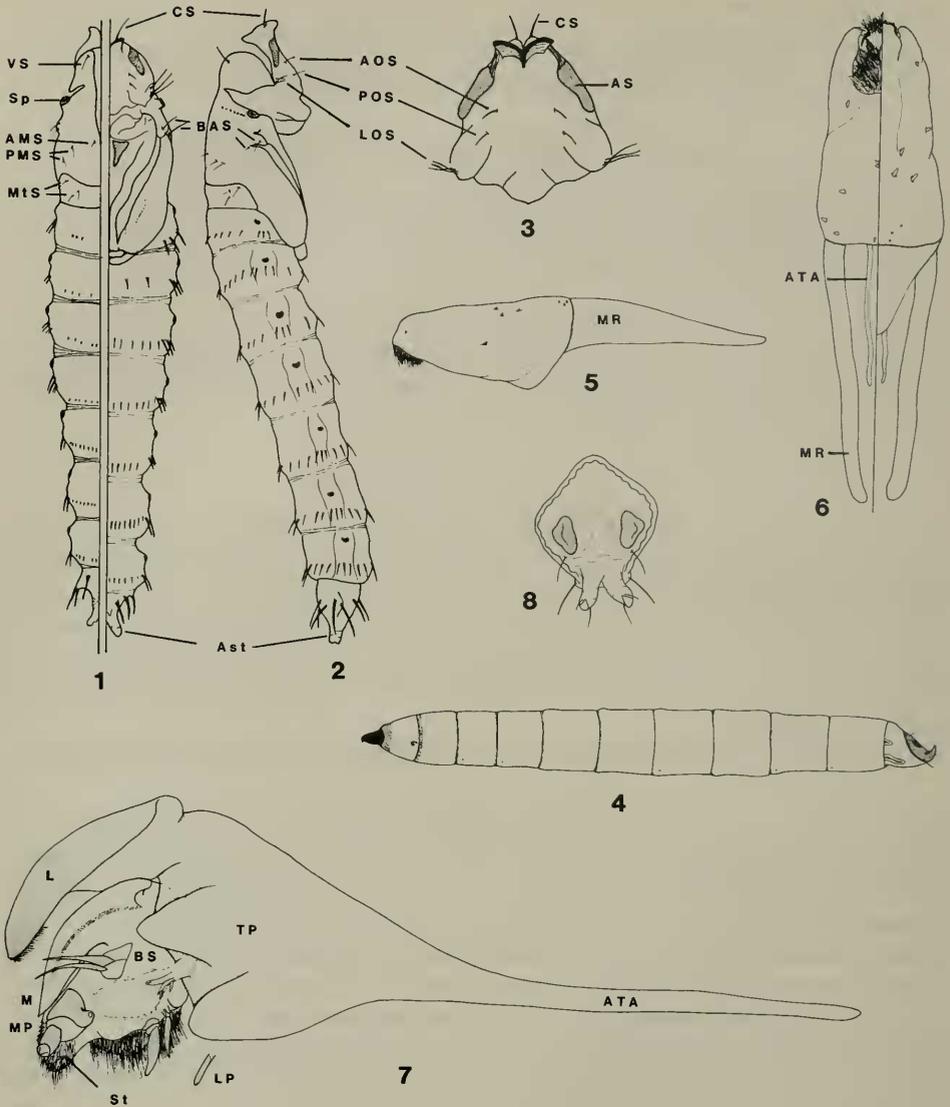
Triptotrichia fasciventris Loew, 1874: 380.

Dialysis fasciventris (Loew): Leonard, 1930: 65; Webb, 1978: 420.

Pupa (Figs. 1-3).—Length 13.0-22.0, 17.8 mm ($N = 3$), width 3.3-3.8, 3.6 mm, 3.5-5.8, 5.0× longer than wide. Aedeaticus, obtect, dark yellow to pale brown.

Head separated from thorax by cephalothoracic suture anterior to mesothoracic spiracle, extending ventrally from middle of dorsum to beneath sheath of mouthparts. Antennal sheath (AS) narrow, fuscous, rounded apically, about 2.0× longer than basal width. Callus seta (CS) 1, lateral orbital setae (LOS) 3, vertical seta (VS) 1, anterior mesonotal seta (AMS) 1, posterior mesonotal setae (PMS) 2, basal alar setae (BAS) 2. Mesothoracic spiracle (Sp) distinct, fuscous, lying anterolateral. Ventrally, wing and leg sheaths extend posteriorly over 1st abdominal sternite. Metanotum broad with 3 pairs of setae (MtS), 1 pair situated at basal angle of wing sheath and 2 pairs close together sublaterally.

Abdominal segments I-VII with lateral spiracle and 3 lateral spines. Tergites I-VII with transverse row of spines on caudal 1/3 of each segment, increasing slightly in size on posterior tergites. Sternite I without spines. Sternite II with 4 ventral spines. Sternites III-VII with transverse row of spines on caudal 1/3 of segment, increasing in size on posterior sternites. Terminal abdominal segment distended caudally to form 2 obtuse projections (Fig. 1, 2); dorsal surface with 2 lateral spines; lateral margin with broad tubercle bearing 3-4 fine spines; ventral surface with 2 lateral spines.



Figs. 1-8. *Dialysis fasciventris*. 1-3, Pupa. 4-8, Larva. 1, Dorsal/ventral view. 2, Lateral view. 3, Frontal plate. 4, Lateral view. 5, Cranium, lateral view. 6, Cranium, ventral/dorsal view. 7, Mandibular-maxillary complex, lateral view. 8, Anal plate. Abbreviations: AS = antennal sheath; AMS = anterior mesonotal seta; AOS = anterior orbital seta; Ast = aster; ATA = anterior tentorial arm; BAS = basal alar setae; BS = basal sclerite; CS = callus seta; L = labrum; LOS = lateral orbital setae; LP = labial palp; M = mandible; MP = maxillary palp; MR = metacephalic rod; MtS = metanotal setae; PMS = posterior mesonotal setae; POS = posterior orbital seta; Sp = spiracle; St = stipes; TP = tentorial phragma; VS = vertical seta.

Larva (Figs. 4-8).—Length of mature larva 25.6 mm, width 3.7 mm, 6.9× longer than wide. Body fusiform, pale white to ivory, holopneustic.

Cranium (Figs. 5-6) hemicephalic, dark brown to black, heavily sclerotized, about 1.5× longer than wide, tapering anteriorly; posterior ¼ of head retracted

Table 1. Comparison of the morphological characters of the pupal stage of *Dialysis* and *Coenomyia*.

<i>Dialysis</i>	<i>Coenomyia</i>
Length 13.0–22.0 mm	Length 26.6–36.9 mm
Callus seta 1	Callus seta 1
Anterior orbital seta 1	Anterior orbital seta absent
Posterior orbital seta 1	Posterior orbital setae 3
Lateral orbital setae 3	Lateral orbital seta 1
Vertical seta 1	Vertical seta absent
Anterior metanotal seta 1	Anterior metanotal seta absent
Posterior metanotal setae 2	Posterior metanotal seta absent
Basalar setae 2	Basalar seta 1
Metanotal setae 3	Metanotal seta absent
Abdominal segments I–VII with lateral spines	Abdominal segments I–VII with lateral spines
Posterior row of spines on abdominal tergites I–VII	Posterior row of spines on abdominal tergites III–VII
Posterior row of spines on abdominal sternites III–VII	Posterior row of spines on abdominal sternites III–VII
Abdominal tergites without dark brown punctation	Abdominal tergites IV–VI with dark brown punctation
Abdominal sternites without dark brown punctation	Abdominal sternites II–VII with dark brown punctation
Abdominal sternite II with 2 mediolateral spines	Abdominal sternite II without spines

into 1st thoracic segment, setae absent, although numerous minute sensory pegs (Fig. 6) situated on ventral and lateral surface. Ocelli absent. Labrum short, wedge shaped, curved ventrally; epipharynx with dense spinous brush. Mandible hypognathus. Antenna reduced. Metacephalic rods (MR) broad dorsoventrally, flattened laterally, extending posteriorly into 1st thoracic segment, firmly attached anteriorly to posterior margin of cranium.

Mouthparts (Fig. 7) or mandibular-maxillary complex with large basal sclerite (BS) bearing mandible (M), maxillary palpus (MP), stipes (St), and 2 pairs of flat, elongate blades: 1 pair situated dorsal to base of maxillary palpus and directed anteriorly, a second pair situated posterior to base of maxillary palpus and directed ventrally. Mandible (M) large, dark brown, sickle shaped, heavily sclerotized, tapered ventrally, central canal visible. Maxillary palpus with 2 segments, about 1.7× longer than wide; basal segment short, broad; apical segment reduced, oblong. Stipes and medial surface of basal sclerite with dense brush of elongate spines. Tentorial phragma (TP) attached dorsally to labrum (L) and posteriorly to basal sclerite; attached to anterior surface of tentorial phragma are 3 membranous projections surrounded by membranous fanlike structure bearing numerous branching filaments along its border; anterior tentorial arms (ATA) narrow, elongate, tapering posteriorly. Labial palp (LP) with 1 segment, elongate, situated posterior to ventral surface of basal sclerite.

Thorax with 3 distinct segments, setae absent. Thoracic segments 1 and 2 with broad band of flat scalelike spines (Figs. 3, 4) along anterior margin. Thoracic tergite 1 with subtriangular, mediolateral patch of fuscous pigmentation. Prothoracic spiracle small, with dorsal arc of dark brown pigmentation.

Table 2. Comparison of morphological characters of the larva of *Dialysis*, *Coenomyia*, and *Arthropeas*.

<i>Dialysis</i>	<i>Coenomyia</i>	<i>Arthropeas</i>
Length 25.6 mm	Length 38.0–48.0 mm	?
Holopneustic	Holopneustic	?
Body fusiform	Body fusiform	Body fusiform
Cranium dark brown to black, partially withdrawn into first thoracic segment	Cranium dark brown to black, partially withdrawn into first thoracic segment	Cranium dark brown to black
Labrum wedge shaped	Labrum wedge shaped	?
Epipharynx with spinous brush	Epipharynx with spinous brush	?
Stipes with spinous brush	Stipes with spinous brush	?
Maxillary palp with two segments	Maxillary palp with two segments	?
Basal sclerite with pair of anterior and ventral blades	Basal sclerite with pair of anterior and ventral blades	?
Metacephalic rods broad, flattened laterally, extending posteriorly into first thoracic segment	Metacephalic rods broad, flattened laterally, extending posteriorly into first thoracic segment	Metacephalic rods broad, flattened laterally, extending posteriorly into first thoracic segment
Thoracic segment 1 with anterior border of spines	Thoracic segment 1 without anterior border of spines	Thoracic segment 1 without anterior border of spines
Dorsal surface of thoracic segment 1 without pigmentation	Dorsal surface of thoracic segment 1 with 5 areas of pigmentation	Dorsal surface of thoracic segment 1 with one median area of pigmentation
Ventral surface of thoracic segment 1 without pigmentation	Ventral surface of thoracic segment 1 with 2 areas of pigmentation	Ventral surface of thoracic segment 1 with 2 areas of pigmentation
Thoracic tergite 1 without punctation	Thoracic tergite 1 without punctation	Thoracic tergite 1 with median patch of punctation
Thoracic sternite 1 without punctation	Thoracic sternite 1 without punctation	Thoracic sternite 1 with punctation along posterior margin
Thoracic segment 2 with anterior border of spines	Thoracic segment 2 without anterior border of spines	Thoracic segment 2 without anterior border of spines
Ventral surface of thoracic segment 2 without pigmentation	Ventral surface of thoracic segment 2 with two small areas of pigmentation	Ventral surface of thoracic segment 2 without pigmentation
Ventral surface of thoracic segment 2 without punctation	Ventral surface of thoracic segment 2 without punctation	Ventral surface of thoracic segment 2 with lateral diagonal row of punctation
Dorsal surface of thoracic segment 2 without punctation	Dorsal surface of thoracic segment 2 with lateral row of diagonal punctation	Dorsal surface of thoracic segment 2 with lateral punctation in shape of inverted "v"
Thoracic segment 3 without lateral spiracle	Thoracic segment 3 with lateral spiracle	Thoracic segment 3 without lateral spiracle

Table 2. Continued.

<i>Dialysis</i>	<i>Coenomyia</i>	<i>Arthropeas</i>
Ventral surface of thoracic segment 3 without pigmentation	Ventral surface of thoracic segment 3 with two small areas of pigmentation	Ventral surface of thoracic segment 3 without pigmentation
Ventral surface of thoracic segment 3 without punctations	Ventral surface of thoracic segment 3 without punctations	Ventral surface of thoracic segment 3 with medialateral row of punctation
Dorsal surface of thoracic segment 3 without punctation	Dorsal surface of thoracic segment 3 with diagonal row of punctation	Dorsal surface of thoracic segment 3 with diagonal band of punctation
Abdominal segments I–VII without lateral spiracle	Abdominal segments I–VII with lateral spiracle	Abdominal segments I–VII without lateral spiracle
Abdominal tergites II–VII without punctations	Abdominal tergites II–VII with punctations in diagonal row on tergites II and VII, in "V" shape on tergites III–VI	?
Anal plate diamond shaped	Anal plate spherical	Anal plate diamond shaped
Posterior spiracle subtriangular, on ventral half of anal plate	Posterior spiracle oblong, on dorsal half of anal plate	Posterior spiracle oblong, on dorsal half of anal plate
Anal plate with sculptured border	Anal plate without sculptured border	Anal plate with sculptured border

Abdominal segments I–VII with narrow ring of short, minute spines along anterior margin; setae absent. Abdominal segment VIII (anal) in dorsal view with anal plate (Figs. 4, 8), large, fuscous to dark brown, heavily sclerotized, surface rugose, with 2 caudal tubercles, each bearing 2 elongate coarse setae; a coarse seta situated lateral to caudal projection; on young larvae 3 fine setae are present, situated ventrolateral and dorsomedial to posterior spiracle (the 2 dorsomedial setae apparently lost on mature larvae); posterior spiracle dark brown, situated on ventral ½ of anal plate, with lateral diagonal slit; outer margin of anal plate with serpentine sculpturing; in ventral view abdominal segment VIII (Fig. 4) with median anal ring oblong.

Remarks. — The larvae of *Dialysis fasciventris* were collected from the top 5 cm of soft organic soil in a beech and sugar maple forest in Vermilion County in eastern Illinois. Six larvae were collected from 42 soil samples (each sample 890 sq. cm), giving an average abundance of 1.57 larvae per square meter.

The pupa of *Dialysis fasciventris* resembles that of *Coenomyia ferruginea* (Table 1), each having a single callus seta, lateral spiracles on abdominal segments I–VII, lateral spines on abdominal segments II–VII, and a ring of posterior spines on abdominal segments III–VII. The pupae differ in the position and number of anterior, posterior, and lateral orbital setae; vertical setae; anterior and posterior mesonotal setae; basal alar setae; and metanotal setae, in addition to the presence or absence of spines on abdominal segments I and II.

The larvae of *Dialysis fasciventris*, *Coenomyia ferruginea*, and *Arthropeas sibirica* (Krivosheina, 1967) are similar in general body shape and appearance (Table 2). The cranium in each is dark brown to black, heavily sclerotized, and partially withdrawn within the first thoracic segment, and each has a pair of broad metacephalic rods extending posteriorly from the posterior margin of the cranium into the first thoracic segment. The larvae differ in a number of other morphological characters.

Dialysis has usually been considered a rhagionid fly (Aldrich, 1905; Cole, 1969; Curran, 1965; Steyskal, 1953; Webb, 1978; Williston, 1888), Rhagionidae: Rhagioninae (James, 1965; Leonard, 1930; Williston, 1896, 1908), or Rhagionidae: Bicalcarinae (Brues et al., 1954). Nagatomi (1975a) defined the family Coenomyiidae and included the genera *Coenomyia*, *Anacanthaspis*, *Arthropeas*, *Odonotosubula*, and *Dialysis*. He (1975a, 1975b, 1977) associated *Dialysis* with *Coenomyia* and *Arthropeas*.

In a study of 21 genera of lower brachycerous Diptera in the Nearctic Region, Webb (1981) examined 53 morphological characters of adult males and females. Two phylogenetic (cladistic) and three phenetic methods were used in developing and interpreting the relationships of these genera.

Phylogenetic methods: A cladogram was developed which (1) reflected the least number of convergences for all character states considered and (2) was rooted from a hypothetical ancestor possessing the plesiomorphic state for all 53 characters using the Wagner algorithm.

Phenetic methods: Phenetic similarities were analyzed using CLUSTER (written by Dr. R. B. Selander, University of Illinois) and phenograms were produced using UPGMA (unweighted pair-group method using arithmetic averages) for Pearson-product moment correlation coefficients, average taxonomic distances, and mean character differences.

The two phylogenetic analyses associated the genera: *Dialysis*, *Coenomyia*, and *Arthropeas*. The three phenetic analyses closely associated *Dialysis* and *Coenomyia*, but separated *Arthropeas* from these genera and associated it with *Arthroceras*. Most recently, James (1981) included *Dialysis* in the Xylophagidae, based on the strong similarity in the larvae of *Coenomyia*, *Rachicerus*, and *Xylophagus*. However, because of the divergence of the adults, he grouped *Dialysis*, *Coenomyia*, and *Arthropeas* in the subfamily Coenomyiinae. These five analyses showed no association between *Dialysis*, *Coenomyia*, or *Arthropeas* and *Xylophagus* or *Rachicerus*, and reinforce Nagatomi's association and grouping of *Dialysis*, *Coenomyia*, and *Arthropeas* in Coenomyiidae (Nogatomi, 1975a).

The larvae of *Dialysis* show a close association with the larvae of *Coenomyia* and *Arthropeas* in the general body shape and appearance, the mandibular-maxillary complex (not described for *Arthropeas* by Krivosheina, 1967), metacephalic rods, and anal plate. Also, the larvae of *Dialysis* and *Coenomyia* are both holopneustic. Here again, the characteristics of the larvae of *Dialysis*, *Coenomyia*, and *Arthropeas* reinforce Nagatomi's (1975a) grouping of these genera into the family Coenomyiidae.

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